Making-with the Environment through More-Than-Human Design

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Abstract: Current climate and ecological crises require questioning currently dominant understandings and relations to nonhumans. While design is a human-centered field and practice, many intruders or competing theories challenge human-centered approaches and propose ways to include nonhumans in design. This article explores different perspectives for post-anthropocentric design approaches and focuses on how design can approach the notion more-than-human as an intruder to human-centered design. Proposing practice-based studies of making-with the environment as an alternative to human-centered design, it explores how to design beyond ideas of "human progress". Firstly, more-than-human and related concepts are introduced. Secondly, how human-centered design can be challenged is explained through the concept of core theories and intruders, relating it with "more-than-human" and posthuman theories. Afterwards, traditional knowledge is introduced as a concept to explore more-than-human approaches, and a case study is introduced as a post-anthropocentric making activity. The case study demonstrates that designers should acknowledge and listen to traditional and indigenous knowledges, while shifting to a more-than-human design approach.

Keywords: Intrusions to human-centered design, decentering humans in design, practice-based research, more-than-human.

1. Introduction

This article attempts to see how design can approach "nonhuman" and "more-than-human", through reviewing literature and proposing a case study to reexplore these notions. "Nonhuman" and "more-than-human" are understood as referring to all living and not living things that are not human, from phenomenological and relational perspectives, rather than a rationalistic one.

As the world is going through many changes, and with accelerated crises due to climate change, looking at the more-than-human side of things may provide guidance on how to learn and integrate with current world conditions (Robin, 2018). Finding ways to interrogate the problems caused by the Anthropocene and human-centeredness such as the climate cri-

sis, biodiversity loss, cultural manipulations, increased poverty, degradation of natural resources (Dalby, 2015) is urgent and significant. A way to overcome these problems in design studies can be through reconsidering currently dominant ways of understanding approaching design - human-centered design (HCD) and coming up with more-than-human perspectives and approaches.

Designing objects/artefacts/things based on human needs is the main approach in the current design discourse. However, influences from more-than-human approaches emphasize that inclusion of nonhuman entities is needed. As humans coexist with the rest of the world and are dependent on nonhuman beings, designing for only human needs would be insufficient. In other words, methods that reconsider relationships with other-than-humans in design studies are crucial.

Before human-centered design became formalized as a design approach, technology was given more importance. Giacomin (2014) defines technology driven design, sustainable design and human centred design as the three major paradigms in design. Human-centered design emerged as a challenge to technology-centered design, and focused on developing products with consideration of user experiences and human needs. However, from a holistic perspective, design has been prioritizing human needs before the 1980s, and not considering other factors such as the environment.

Some criticism has been directed towards human-centered design for taking humans only as "users": Buchanan states that human-centered design is "fundamentally an affirmation of human dignity" (2001, p. 37). When human-centered design approaches humans as users, it leads to forgetting what "human" and designing for "humans" mean, for instance when it is limited to usability or "user-centeredness" (ibid). Furthermore, human-centered design is criticized when it puts human needs as the highest priority (Sznel 2020), as this does not answer any of the problems started with the Anthropocene. It is also discussed if "human-centered" design is really inclusive of all humans. Less privileged people, such as nonwhite, indigenous, people with disabilities, female, older and so on are often overlooked in the category of humans (Allen, 2010; Forlano, 2017; Jones & Jones, 2020). Acknowledging this, the paper proposes that incorporating traditional knowledges could bring an inclusive and equal approach in design processes, not only for less privileged humans, but also nonhumans. Furthermore, it argues that traditional knowledge can be employed as an intruder for transforming human-centered design into a "more-than-human" design approach.

To incorporate traditional knowledge into more-than-human approaches, an example case study with an autoethnographic documentation is demonstrated. Taking this case study of "making-with the environment", the paper explores how to design beyond ideas of "human progress" through practice-based research (PBR), which can be defined as post-anthropocentric making activities. The example is given with wool material and felting, taking more-than-human sources and the material as primary design entities. To emphasize the nonhuman actors, functions or user-centered approaches do not play any role in the process. Ways to look from other-than-human's perspectives and to study their relations to humans

through design are suggested through PBR, which takes knowledge from the practice itself. The aim is not to generalize, but to provide an insight into what has been used already, and what future studies could be.

In the paper, firstly the meaning of nonhuman is refined through an examination of literature. Then the changes in human-centered design, and how human-centeredness should be further challenged is clarified. Afterwards, nonhuman and more-than-human approaches in design are discussed through intruders and core concepts, suitable here as they conceptualize the interaction between paradigms, dominant and emerging theories. The paper concludes by revising design approaches to nonhumans considering these different perspectives, and provides a practice-based study example, to illustrate how the emphasis on nonhuman and more-than-humans in design can be applied.

2. Methods and Limitations

This paper consists of a literature review, an example case study and proposals for future studies to shift from anthropocentric approaches. The literature review about "nonhuman" influences was made to identify gaps in design research. Academic sources were primarily used, with the addition of art, design and craft related online resources. In the case study, an autoethnographic documentation demonstrates the outcomes from a practice-based approach. Theoretical and practical perspectives are a result of former personal knowledge, lectures and literature search.

A literature search was made for articles containing design approaches, that involve keywords "nonhuman", "posthuman", "more-than-human", "non-anthropocentric", and "other-than-human". Review for the design discussion part started from the Design and Applied Arts database, Google Scholar. Alternative websites and sources were included as the nature of the research involves design works. Some resources were excluded due to space limitations and as they were outside of the scope. Some approaches other-than human-centered design involve technology, prioritization of companies or economics. To keep the focus on "nonhuman", and as their approach did not involve non-anthropocentric perspectives, these examples were not included.

Perspectives related to nonhumans in design focus on different elements, such as environment or technology. Terms such as nonhuman, posthuman, more-than-human, non-anthropocentrism, other-than-human refer to similar issues in design, with some differences. The studies in design with relevant discussions were used to make a mapping, which includes keywords used for these articles:

Figure 1. Main keywords from reviewed articles on nonhuman.

The keywords are categorized according to the term they use into relevant groups, such as technology, production technique and environment. Related approaches from nonhuman actors, taking environment/nature as key concepts include: Multispecies design, making-with the ecosystem, more-than-human, posthuman, nonhuman agency, beyond HCD, co-design, and co-creation with other entities. In design, ecological understandings and approaches are studied to tackle issues brought by the Anthropocene. These studies can be brought further to help understand other entities, the environment, and the world.

3. Making Sense of Nonhuman Approaches

3.1 The Core Theories and Intruders Concept

In this section, how design can turn into a non-anthropocentric era is discussed through the core theories and intruders concept (Lakatos, 1999). According to Lakatos (ibid), in any research program there are certain paradigms that stand at the center, which are called core theories. Core theories have protective belts that support the current paradigm, and intruders that challenge these paradigms. The 'scientific logic of discovery', as explained by Lakatos, is introduced here to help give a clearer understanding of human-centered design and its "challengers". The model states that intruders challenge the core theory by applying several methods. It shows how there are a "core of claims and reasons", and how "an environment of heuristics" is embedded in this core (Thomsen & Botin 2014, p. 2). In other words, the core theory is the most accepted theory from a specific field or domain, and supporting hypotheses verify the core theory. However, there are intruders that challenge these core theories, which can be within the same field, or from other fields.

The core theories and intruders concept was selected to make clear how design can be rethought from post or non-anthropocentric points of view. Posthumanism and more-than-human concepts may sometimes be complex and difficult to understand. The intruders concept helps define the issue of design being human-centered in a clear way, and it demonstrates how posthumanist theories can challenge this human-centeredness concretely.
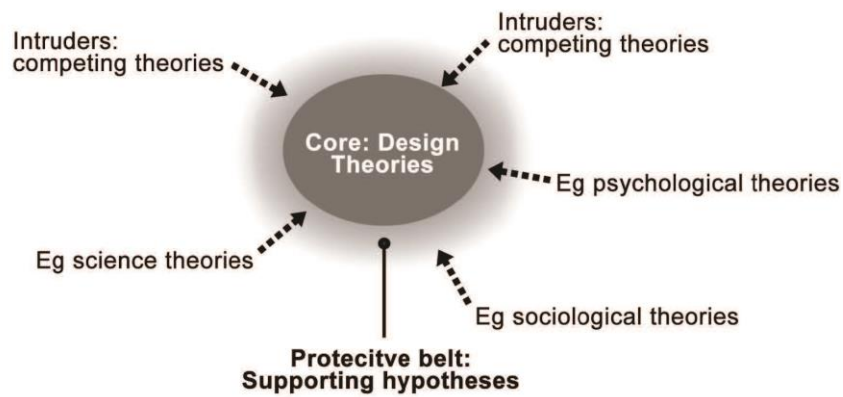
Figure 2. A graphical interpretation hard core of theories by Imre Lakatos, proposed by Thomsen & Botin (2014, p. 7), which is inspired by a figure of Martina Keitsch

As mentioned, since the 1980s, the core theory in design involves human (or user) centred design (Forlano 2017). However, there are many intruders that challenge this theory, which could lead to a paradigm shift in the future. These intruders have emerged from a literature search that consists of design and nonhuman&posthuman as keywords. Then the concepts of posthumanism, making/with, Actor Network Theory, posthumanism and X-centred design have been selected as examples of intruders.
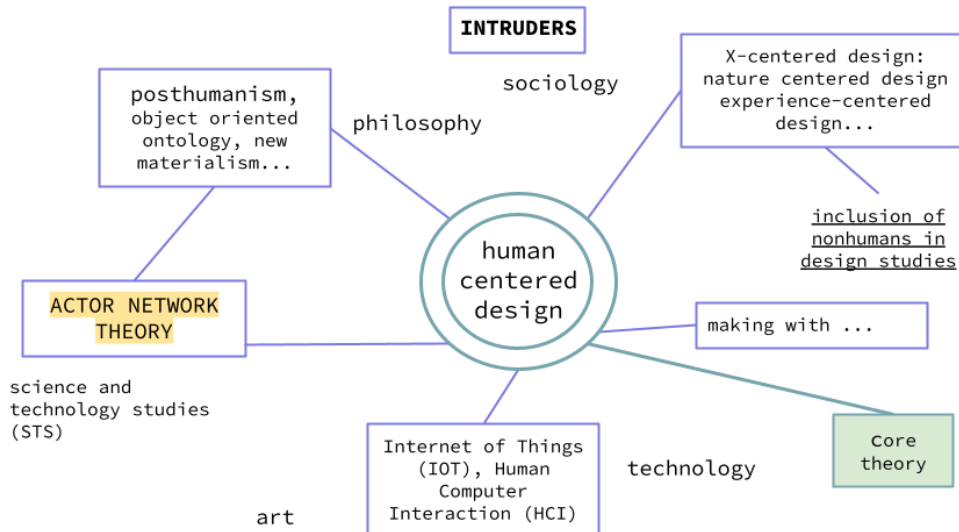
Figure 3. An interpretation of "hard core theory" model of Lakatos, designed by the author: As a part of this paper's argument, human-centered design is taken as the core theory, and intruders include emerging theories that are related to decentering humans in design

From several disciplines, intrusions emerged, stating that nonhumans, more-than-humans and other-than-humans should be involved in practices and even decision making. Some example intrusions in design are from technology and environment: Decentering humans from

design, non-anthropocentric approaches, sustainability studies, IOT and technological approaches can be taken as intruders. For instance, studies on nature-centered design (Tarazi et. al. 2019), multispecies design (Gatto & McCardle 2019), co-creating with urban ecosystems (Pettersen et al.2018) or Human-Nature Interaction focus on the environment, while others focus on technology, materials or objects. Some of these intruders also take objects as the central interest (animism, OOO…).

3.2 Nonhuman, More-than-Human and Other-than-Human

In this section, through examination of the literature, terms related to nonhuman and more-than-human are defined. Looking at the world from the other's point of view, in opposition to human-centrism is the subject of many studies. One example is the article "What is it like to be a bat" (Nagel 1974). Nagel goes beyond observing from the human side: He explores an "objective phenomenology not dependent on empathy or the imagination" (Vennatrø & Høgseth 2021). He argues that because of the "elusive nature of consciousness, ontological inquiry into the nonhuman can only remain speculative" (Flanagan & Frankjær 2019: 240). Surrounded by their own humanity, it is often argued that human perspective will always remain anthropocentric and unable to grasp nonhuman perspectives (ibid).

Nonhuman, in the most basic sense has a literal meaning: It is what is "not human". While it was also used to separate humans from other living creatures, for instance as beings other than human beings ("nonhuman", Merriam-Webster.com, n.d.), in this paper the meaning refers to things that are not human. Here, not only animals or plants, but also entities such as rocks, wind, materials or human-made objects are taken as nonhumans (see Ingold 2007). Although these concepts were explored in design studies before, in this paper, nonhuman and human entanglement is explored through the concept of living in an environment and not being in contradiction with.

More-than-human approaches emphasize and refer to the "earthly nature" and environment, a term first brought up by Abram (1996) in the subtitle of The Spell of the Sensuous as "Perception and Language in a More-than-human World". Another similar term is "other-than-human", referred as a "conceptual shift in anthropology and other social sciences seeking to avoid human exceptionalism and, instead, extending the social to other entities" (Blanco-Wells, 2021, p. 2). Lien and Pálsson (2019, p. 3) state that in the conventional sense, other-than-human is not restricted to the "living". With the geological era of the Anthropocene, humans dwell in the "geologic", which also has agency according to Bennett (2010).

Posthuman, nonhuman, and more-than-human concepts are all intertwined in the posthuman theories. Forlano (2017) proposes that design approaches can be based on these theories, and that this can redirect practice and theories of design to non-anthropocentric perspectives. Posthumanity is "an emergent field of enquiry" (Braidotti 2019, p. 31), which arose from ideas that sought to make sense of the dissolution of human and nonhuman boundaries, and tries to combine "hybrid ways of thinking agency and body" (Iezzi 2021, p. 11). According to Smelik (2020, p. 7), posthuman "interrogates what it means to be human".

The Latin prefix "post" may signify that "posthuman" is what comes after the human, but this linear framework is not consistent for posthumanism (ibid, p. 7).

As humans are already living in an environment, and "nonhumans" are part of humans' lives, it is not possible to separate humans from nonhumans (that is human's environment). Looking at the relationship of artificial/non-artificial worlds from these perspectives could be where design studies could mediate or be involved, to communicate the environment aspect further, in addition to other often dominant concerns such as economy. Understanding and "living with" the more-than-human is necessary, even when designing for humans, if humans want to live in the environment without being in contradiction with it. Therefore, when designing for humans, nonhumans should be taken into account, as humans cannot exist without their surroundings: Haraway refers to this relationship of humans and nonhumans as a performance of intricate dance (2009). Tsing writes that "human nature is an interspecies relationship" (2012, p.144). Even when studying humanity accurately, there is a need to situate "humans within historically and culturally specific networks of interdependence with animal, plant, microbial, and object others" (Magnone, 2016, p.16).

3.3 Nonhumans in Related Theories of Posthumanism

Posthumanism includes science and technology studies (STS), ANT and OOO theories. In ANT, which has been developed in STS, agency is described not from the actors (the nonhumans or humans), but through the relations between them. According to ANT, humans and nonhumans are taken as equal "agents". Latour (1994, 1999) suggests that non-human beings are also a part of the social structure, and everything in the world (social and natural) exists in ever-changing networks of relationships.

In design, ANT dissolves connections between designers, users, products and other actors and technical objects (Yaneva, 2009). To study objects and their relations to humans, ANT is cited by new related philosophies that do not centralize humans, but take objects as equal "agents", for instance OOO and New Materialism. These approaches are defined under the "posthumanism" umbrella (Kuby 2017), together with STS-perspectives such as ANT. With theories such as New Materialism and OOO, the subject of nonhuman has gained new importance. As these theories take "matter" as the core, they relate to the act of making and design culture. Therefore, to study the nonhuman from the perspectives introduced above, considering these philosophies can bring fruitful discussions in design. New Materialism is described as "a specific domain within posthumanism that gives special attention to matter by avoiding binary understandings such as mind-body and human-nonhuman" (Leanord 2020). OOO is a philosophical theory that takes every entity or "thing" as equal: Harman states that it deals with the "real and sensual" qualities and aesthetics of objects (2015).

Many approaches with human and nonhuman mentioned are still binary, and the division is already reflected in the distinction between human and nonhuman As OOO and New Materialism do not have the similar binaries as in rational knowledge, they can lead to an understanding of what non-binary approaches can entail. As OOO "subscribes neither to Nature

nor to Non-Nature" (Morton, 2011, p. 164), it offers a middle path between them, by rejecting nature and essentialist Matter. Therefore, it also offers a non-binary path that differs from ecocriticism (ibid).

4. The Interpretation and Exploration of Nonhuman Through Ecological Approaches: Traditional Knowledge and More-than-Human World

In this section, traditional and indigenous knowledge (IK) are proposed as possible intruders to human-centered design, to adopt to a "more-than-human" design paradigm. Traditional, indigenous, and local knowledge refer to similar things, with some differences. IK, as a part of Traditional Ecological Knowledge (TEK), is the set of knowledge and beliefs passed down by local people from generation to generation (Berkes, 1993). Here it is also taken as what remains as an alternative knowledge source other than Western knowledge. This knowledge can be applied into design studies, which is mainly based on Western traditions and human-centered design.
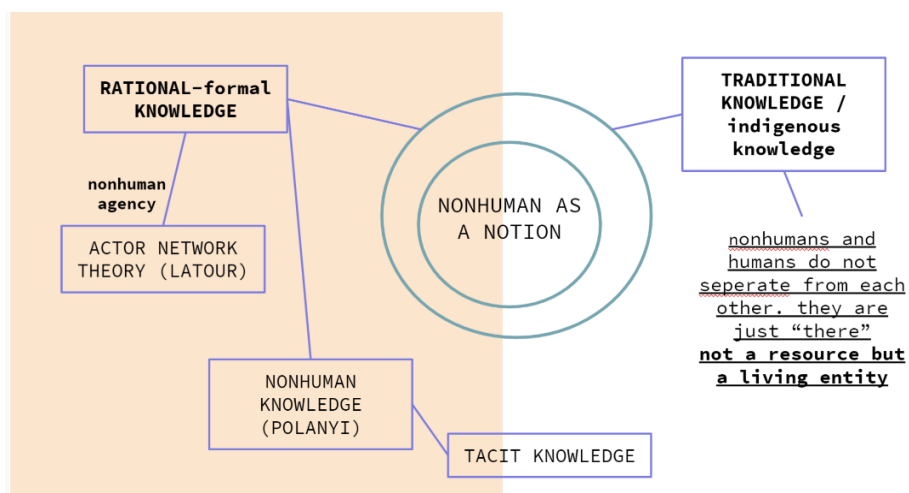
Figure 4. How "nonhuman" is approached in rational and traditional knowledge: The figure describes the distinction between approaches and exemplifies that traditional knowledge can be used further to understand nonhumans.

Figure 4 explains how traditional knowledge and rational knowledge approach nonhumans, and why it is necessary for design to consider and acknowledge human-nonhuman relationships in traditional knowledge: In traditional knowledge humans and nonhumans are not separated from each other, as humans already live with the environment. The environment is considered not as a resource, but as a living entity in many cases. For example in New Zealand rivers are seen as living things rather than resources in IK, and a river has gained the legal status as a person (Roy 2017). These discussions are also related to Western systems idealizing rationality (Zagórska, 2010). "Logos" versus "mythos", which are two complementary modes of thinking relates to rational knowledge versus traditional knowledge: The "logos thinking mode" is "rational, discursive, ideational and ordering" (ibid, p.22). Mythos,

which is a form of nonhuman knowledge, "encompasses the deepest, indispensable needs of a human being", and is imaginative-affective, visual and intuitional (ibid, p.22). A similar approach can be made for design studies to understand the differences between rational and traditional notions further.

In this study, the emphasis is made on how more-than-human approach relates to the ways of living from traditional knowledge. There is no binary definition in traditional knowledge that separates humans from nonhumans, as the nonhumans were already immersed in their ways of living. Therefore, in traditional knowledge and cultures, relationships between humans and nonhumans are not binary. This could be used in design studies to approach nonhumans more consciously.

TEK and IK are used in design, craft and making activities. Traditional handicrafts and several production techniques already emerge from this knowledge. Material knowledge of indigenous societies has shaped today's understanding of material to some extent. With changes in the industry and lifestyles, indigenous "ways of knowing" or "nonhuman approaches'" are however not included in the mainstream knowledge. "Slow Designers" movement is an example of alternative approaches. It consists of craft-inspired design practices that "build on the heritage and history of local communities, using environmentally friendly materials" (Gasparin et. al., 2020, p. 551), which can reduce humans' "over-reliance on the Earth System" (ibid, p. 551). Likewise, a closer look at traditional knowledges today can lead way to more-than-human approaches in design.

According to Deloria (1999), there is a great difference between how American Indians perceive nature, and how non-Indians do. In fact, when a non-Indian asks Indians on nature or environment, Indians get confused. Indians do not "love" nature, as nature is not abstracted / isolated from them in the first place: It is the western European context that separates human experience from the environment:

> "Indians do not talk about nature as some kind of concept or something "out there."
> They talk about the immediate environment in which they live. They do not embrace
> all trees or love all rivers and mountains. What is important is the relationship you
> have with a particular tree or a particular mountain." (Deloria 1999, p. 223)

In this review, making-with approach in design studies were found to be most relevant to the intersection of TEK and nonhuman: Smitheram and Joseph's Phenomenal Dress project (2020) is an example for how Māori (indigenous) knowledge is related to making-with the environment. They demonstrate a more-than-human relationship, by employing material thinking, making-with approaches and post-human theory from Māori perspectives. They specifically acknowledge the wind, Māori perspectives and Karekare beach. The collaborator for their project is the environment and the ecosystem (ibid). Māori knowledge is directly listened to, together with nonhuman approaches and design, by taking the wind not as an inspiration but as an entity in the design process. Wind is a part of the designed piece, as it is made with the wind. This correlates with Heidegger's sense of being with the world and co-existing with other entities (1962).

5. A Practice-based Study with Wool through More-than-human Entanglements, and Making-with the Environment

Similarly, in this article, the proposed case study involves making-with the environment, through a processed wool material, and several trials in an outdoor environment. A practice-based study exemplifies how design can approach nonhumans, suggesting the approach and the practice itself as a post-anthropocentric activity. PBR can include field-based research and participatory experiments, rather than laboratory tests, and is already used in many design studies (Skains 2018, p. 84). Accordingly, a PBR with wool was taken to several environments to study more-than-human entanglements: This allowed the researcher to understand the impact of the nature and the material more. Similar to Smitheram and Joseph's study (2020), the chosen location has physically and spiritually guided the project.

Figure 5. Walking through different locations during the case study in Trondheim, May 2021.

Through taking the wool material, hot water and soap outside the studio environment to outdoor activities, the idea was to understand how design can collaborate with more-than-human actors. With this, traditional knowledge is employed through felting, which is a traditional and contemporary method for producing textiles or artefacts, by compressing fibers together (mostly wool), using water and alkaline. The example study (Fig. 5, 6) on non-anthropocentric design approaches is meant to lead towards the natural material itself, and involves an approach focusing on the relationship between the material, environment and humans. In the beginning of these exploratory making activities, unprocessed and uncolored wool was used to experiment with, especially in studio setting. However, in this instance the wool used was processed and colored wool, as working with it was relatively easier than working with unprocessed wool. No functional needs or user needs were considered, to keep the process in focus.

Figure 6. Chosen location for the making activity, Trondheim, Norway.

While ANT explains the relational aspects between humans and nonhumans, with this experimentation process, using traditional knowledge and its non-binary definitions of nature/human relationship defined design and making-with process with the environment more thoroughly and in connection with the nonhuman elements. Nature and "others" are entangled together in TEK and IK, as there is a non-binary relationship with the nature, humans and materials. It is mentioned that "indigenous (Maori) ontologies always already assume a profound sameness, and therefore sense of recognition, between the abilities and sensibilities of objects and those of humans." (Jones and Hoskins, 2016). This entanglement and the deep sense of sameness can be experienced by a making-with activity. While craft and making activities usually take place in specific workshops, acknowledging more-than-human entanglements and perspectives in craft-design relationships could create a similar sensibility.

Figure 7. An experiment of making-with the environment (Trondheim, May 2021)
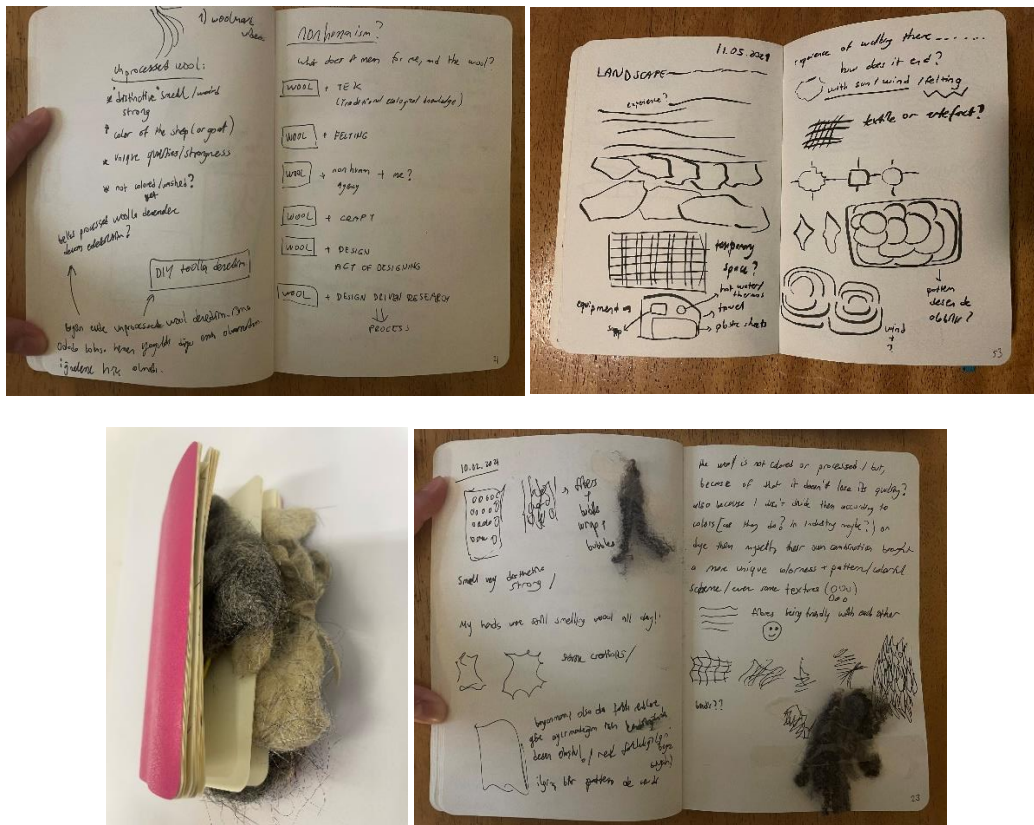
Figure 8. Reflective diaries on wool types and merging traditional knowledge with wool

This autoethnographic documentation is an ongoing process, which aims to emphasize the experiential knowledge, learning with material in the practice, and how environment plays a central part in this process of making. This is demonstrated by analyzing the relationship of the environment and artefacts created, and by using the artefacts themselves, their photos, and written notes from reflective diaries. In the reflective diary, (Fig. 7), Berilsu Tarcan (author 1) questions how to include the temporary space and experience with wool material. Another page reflects on this study and how it brings together wool and TEK, craft, design, act of designing, felting and how all nonhuman elements emerge together.

By acknowledging the surroundings of one-self, a making activity can turn into a more-than-human activity. Drawing from Ingold's (2007) question, "Why should the material world include only either things encountered in situ, within the landscape, or things already transformed by human activity, into artefacts? Why exclude things like the stone, which have been recovered and removed but not otherwise transformed?" (ibid, p. 7), the environment and other-than-humans in this research consist not only the materials or artefacts, but other things such as the clouds, the stones, and the act of making itself: Other elements from the environment that do not belong to human activities can be put forward in these practices as well (Tarcan et al., 2021).

The exploration is shown as a process, what matters most in this study is the making-with activity and relatedness with the location. Therefore it was a conscious choice not to show end results or focused photos of the artefact. The artefacts emerged together with the cliffs and the environment. As the artefacts are made together with the environment, the artefacts are not shown separated from the location.

This exploration has showed alternative ways to "entangle" with the environment for a making activity. The process was educative and challenging for the researcher as it had to involve a preparation period and making it in an environment that she has never visited before, which led to being unprepared for any unknown circumstances. However, this is taken as a part of the challenge and the experience has proven to bring alternative ways of thinking about other-than-humans while designing/thinking in an unknown environment.

6. Tactics and Approaches for Repositioning Making and Design

In the article, an explorative study of making/designing with the environment is proposed as an example. Various methods could be used in design research to enhance these notions. Co-design, participatory design and speculative design already add to a more diverse and equal approach. Other approaches, such as PBR could be experienced to diversify the arguments about nonhumans and traditional knowledges, as it demonstrates the processuality of design. These discussions should be furthered and explored thoroughly.

The general discourse in design today is framed with human-centrism, however there is a start for consideration and research for nonhuman and more-than-human approaches in design (Jönsson, 2014). This shift in design discourse involves nonhuman involvement in design, can be exemplified with studies of technology-human interactions, , and material-driven/ material-based design approaches. In other words, while design is human-centered, many intruders (Lakatos, 1999) such as non or post-anthropocentric approaches, challenge human-centered approaches and propose ways to include nonhumans in design (Forlano, 2017; Smitheram & Joseph, 2020). The case study is one example of how a post-anthropocentric approach could be, taking traditional knowledge into consideration.

Here, the following examples and opportunities are suggested for how this relation can be furthered in design,

- Traditional knowledge can be thought further with the intruders that are decentering humans, also exploring their compatibilities and differences, as there are ways of knowing that go with non-binary definitions and take humans and nonhumans as equals.

- Incorporating traditional knowledge into more-than-human design relates with the emerging movement of decolonizing design (Tunstall, 2013), which suggests designing for anti-oppressive futures, listening to indigenous experiences and challenging eurocentrism. This is an approach that needs to be addressed further.

- Traditional production techniques and TEK can be experimented with and included further in education (Kimmerer, 2002), speculative design, codesign, for instance to connect "ways of making" into today's culture, using local materials and sources.

- Ethics and ways of living together with the environment can be acknowledged in design processes to allow decision making to consider other-than-humans. Examples for this can be material selections, designing for repair, design for sustainability and co-design.

- Considering traditional ways of knowing through nonhuman actors in technology could enrich a more ethical, equal way from technology-related perspectives.

Table 1   Approach examples for design.

Approaches	Keywords in design	Examples and Future Opportunities for Design Studies
Nonhuman approach	Codesign, participatory design	Co-design (Steen, 2013), participatory design projects that have collaborated with entities such as trees (Pettersen 2020), ecosystem (Smitheram & Joseph 2020), cats (Tasdizen 2020) etc.
Traditional knowledge	Production techniques and material knowledge	The use of local materials and knowledge in design and craft (Tarcan & Cox 2019, Tung 2012), slow design movement (Gasparin et. al., 2020).
Traditional knowledge + nonhuman approaches	Approaches to nature, living and respecting nonhuman entities	Designing together with natural entities (Galloway, 2017, Smitheram & Joseph 2020), textiles and nonhumans (Keune, 2021)
Nonhuman approaches + emerging theories of posthumanism	Design studies in sustainability, STS, ANT, OOO	More-than-humans in technology (Giaccardi & Redström, 2020), Learning from the environment (Morrison, & Chisin, 2017). Keune 2021), nature-centred design (Tarazi et al. 2019)
Traditional knowledge + new materialism	Traditions that put nonhumans together with humans, nonbinary approaches	Traditional / indigenous cultures, historical research
Traditional knowledge + new materialism + nonhuman approaches	Decolonization of design, non binary approaches, decentering humans in design	Case studies for the ongoing discussions about inclusion of local communities, design ethics (Rosiek et. al., 2020)

In the table above, directions are summarized with relevant keywords. Some articles are mentioned in multiple places, as they focus on several approaches. These suggestions are not generalized but propose several directions for how design relates to and can continue to explore the topic. These directions could all be implied to emphasize 'nonhumanness' as a notion and explain why it is needed in design and making practices.

7. Conclusion

The shift in the current design discourse towards nonhuman involvement in design is happening through the combination of different perspectives and approaches. Some examples are technology-human interactions, environment and sustainability for design, material-driven/material-based design approaches. ANT's approach for the focus on relations and connections between different actors relates with some parts of traditional and local knowledges. The non-binary approach employed by OOO and New Materialism resonates with traditional knowledges to some extend. However, there is still a need to address making-with activities through traditional knowledges, as these theories still miss a link with political aspects, for instance post- and decolonial theories (Hinton et al. 2015) and equality for all entities.

While this article focused on the connection between nonhumans and design, many studies can be employed on more specific topics, such as the relationship of nonhumans and traditional knowledge. This can contribute to ethical discussions, for example on designing with respect for nonhumans, therefore working in more respectful ways to the environment, as well as to decolonization of design.

From a rationalistic perspective, for humans, it may not be possible to employ and get the full essence of nonhuman knowledge, as they lack the experience. Since a direct experience is not possible, any attempt to understand the essence of the nonhuman could remain fictional. Maybe in the future, acquiring these experiences would be more possible from humans' side with new technologies (Flanagan & Frankjær 2019). Nevertheless, this does not mean humans should stop considering, guessing or experimenting with these perspectives. Nonhumans and humans do not exist in separation from each other. Instead, they are already interwoven and in relation with each other. Finally, from a phenomenological perspective, taking nonhumans into consideration should be explored further not only for design, but for respecting and mutual living with nature by all.

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